

Appendix A: Impact categories and LCIA methods used in this study

Impact category (abbreviation)	LCIA method (units)	Description
Climate change (CC)	IPCC 2013 GWP 100a (kg CO ₂ eq)	Potential for global warming from greenhouse gas emissions.
Ecosystem quality: Freshwater and terrestrial acidification (FTA)	ILCD 2011 Midpoint+ (Mol H ⁺ eq)	Acidification of soils and freshwater due to gas release.
Ecosystem quality: ecotoxicity freshwater (ECF)	ILCD 2011 Midpoint+ (CTU _e)	Harmful effects of toxic substances on freshwater organisms.
Ecosystem quality: eutrophication freshwater (EUF)	ILCD 2011 Midpoint+ (kg P eq)	Changes in freshwater organisms and ecosystems caused by excess nutrients.
Ecosystem quality: eutrophication marine (EUM)	ILCD 2011 Midpoint + (kg N eq)	Changes in marine organisms and ecosystems caused by excess nutrients.
Ecosystem quality: eutrophication terrestrial (EUT)	ILCD 2011 Midpoint + (Molc N eq)	Changes in land organisms from excess nutrients in soil and air.
Human health: cancer effects (CE)	ILCD 2011 Midpoint+ (CTU _h)	Harm to human health that causes or increases cancer risk.
Human health: ionizing radiation (IR)	ILCD 2011 Midpoint + (kBq U-235 eq)	Potential damage to human DNA from ionizing radiation.
Human Health: non-cancer effects (NCE)	ILCD 2011 Midpoint+ (CTU _h)	Harm to human health that is not related to cancer or ionising radiation.

Human health: respiratory inorganics (RI)	PM method (Disease inc.)	Harm to human health caused by particulate matter emissions (respiratory disease).
Human health: photochemical ozone formation (POF)	ILCD 2011 Midpoint + (kg NMVOC eq)	Harm to human health from gas emissions that contribute to smog in the lower atmosphere.
Resource use: Land use (LU)	Soil quality index based on LANCA (Pt)	Depletion of natural resources, change in soil quality, and reduction in biodiversity.
Human health: Ozone depletion (OD)	ILCD 2011 Midpoint+ (kg CFC11 eq)	Air emissions causing stratospheric ozone layer destruction.
Resource use: fossils FF)	CML-IA baseline (MJ)	Depletion of natural fossil fuels.
Resource use: minerals and metals (MM)	CML-IA baseline (kg Sb eq)	Depletion of natural non-fossil fuel resources.
Resource use: dissipated water (DW)	AWARE (m3 depriv.)	Potential for water deprivation to humans and ecosystems globally.

Impact category	Unit	Normalization factor
Acidification	mol H+ eq	55.55555556
Climate change	kg CO2 eq	8097.165992
Ecotoxicity, freshwater	CTUe	42680.32437
Eutrophication, freshwater	kg P eq	1.606941989
Eutrophication, marine	kg N eq	19.54652072
Eutrophication, terrestrial	mol N eq	176.7408978
Human toxicity, cancer	CTUh	1.69E-05
Human toxicity, non-cancer	CTUh	2.30E-04
Ionising radiation	kBq U-235 eq	4219.409283
Land use	Pt	819672.1311
Ozone depletion	kg CFC11 eq	0.053648069
Particulate matter	disease inc.	5.95E-04
Photochemical ozone formation	kg NMVOC eq	40.60089322
Resource use, fossils	MJ	65019.50585
Resource use, minerals and metals	kg Sb eq	0.063653724
Water use	m3 depriv.	11469.20518

Appendix B: Life cycle inventory for each type of hand hygiene

Bar soap inputs	Amount	Unit	Provider
Carton board box production, with offset printing	979865.8468	Kg	Market for carton board box production, with offset printing carton board box production, with offset printing Cutoff, U - GLO
Electricity, medium voltage	11079.52886	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Soap	1.28E+08	Kg	Market for soap soap Cutoff, U - GLO
Tap water	1.22E+12	Kg	Market for tap water tap water Cutoff, U - Europe without Switzerland
Transport, freight, lorry 3.5-7.5 metric ton, EURO3	3.23E+07	Kg*km	Market for transport, freight, lorry 3.5-7.5 metric ton, EURO3 transport, freight, lorry 3.5-7.5 metric ton, EURO3 Cutoff, U - RER
Transport, freight, lorry >32 metric ton, EURO4	7.74E+10	Kg*km	Market for transport, freight, lorry >32 metric ton, EURO4 transport, freight, lorry >32 metric ton, EURO4 Cutoff, U - RER
Transport, passenger car	42213.47248	Km	Market for transport, passenger car transport, passenger car Cutoff, U - RER
Washing, drying and finishing laundry	1.86E+09	Kg	Market for washing, drying and finishing laundry washing, drying and finishing laundry Cutoff, U - GLO
Bar soap outputs			
Waste paperboard	979865.8468	Kg	Market for waste paperboard waste paperboard Cutoff, U - GB
Wastewater, unpolluted, from residence	1.22E+12	L	Market for wastewater, unpolluted, from residence wastewater, unpolluted, from residence Cutoff, U - row
Hand gel 1 inputs			
Ethanol, without water, in 99.7% solution state, from fermentation	9.62E+08	Kg	Market for ethanol, without water, in 99.7% solution state, from fermentation ethanol, without water, in 99.7% solution state, from fermentation Cutoff, U - GLO
Glycerine	2.68E+07	Kg	Market for glycerine glycerine Cutoff, U - RER
Hydrogen peroxide, without water, in 50% solution state	3651569.712	Kg	Market for hydrogen peroxide, without water, in 50% solution state hydrogen peroxide, without water, in 50% solution state Cutoff, U - RER

Water, deionised	2.18E+08	Kg	Market for water, deionised water, deionised Cutoff, U - Europe without Switzerland
Electricity, medium voltage	1463851.872	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Electricity, medium voltage	1829814.84	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Electricity, medium voltage	426956.796	Kwh	Electricity voltage transformation from high to medium voltage electricity, medium voltage Cutoff, U - GB
Injection moulding	6.29E+07	Kg	Injection moulding injection moulding Cutoff, U - RER
Polyethylene terephthalate, granulate, bottle grade, recycled	5.71E+07	Kg	Market for polyethylene terephthalate, granulate, bottle grade, recycled polyethylene terephthalate, granulate, bottle grade, recycled Cutoff, U - row
Polyethylene, high density, granulate	5855407.488	Kg	Market for polyethylene, high density, granulate polyethylene, high density, granulate Cutoff, U - GLO
Electricity, medium voltage	406625.52	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Printed paper, offset	182981.484	Kg	Market for printed paper, offset printed paper, offset Cutoff, U - GLO
Transport, freight, lorry 3.5-7.5 metric ton, EURO3	3.19E+08	Kg*km	Market for transport, freight, lorry 3.5-7.5 metric ton, EURO3 transport, freight, lorry 3.5-7.5 metric ton, EURO3 Cutoff, U - RER
Transport, freight, lorry >32 metric ton, EURO4	7.65E+11	Kg*km	Market for transport, freight, lorry >32 metric ton, EURO4 transport, freight, lorry >32 metric ton, EURO4 Cutoff, U - RER
Transport, passenger car	2.81E+07	Km	Market for transport, passenger car transport, passenger car Cutoff, U - RER
Hand gel 1 outputs			
Ethanol	9.43E+08	Kg	N/A: elementary flow
Ethanol	1.92E+07	Kg	N/A: elementary flow
Hydrogen peroxide	3578540	Kg	N/A: elementary flow
Hydrogen peroxide	73031.42857	Kg	N/A: elementary flow
Waste paperboard	182981.484	Kg	Market for waste paperboard waste paperboard Cutoff, U - GB
Waste polyethylene	5855407.488	Kg	Market for waste polyethylene waste polyethylene Cutoff, U - GB
Waste polyethylene terephthalate	5.71E+07	Kg	Market for waste polyethylene terephthalate waste polyethylene terephthalate Cutoff, U - GB

Wastewater, from residence	2.45E+08	L	Market for wastewater, from residence wastewater, from residence Cutoff, U - row
Hand gel 2 inputs			
Glycerine	2.68E+07	Kg	Market for glycerine glycerine Cutoff, U - RER
Hydrogen peroxide, without water, in 50% solution state	3651569.712	Kg	Market for hydrogen peroxide, without water, in 50% solution state hydrogen peroxide, without water, in 50% solution state Cutoff, U - RER
Isopropanol	8.65E+08	Kg	Market for isopropanol isopropanol Cutoff, U - RER
Water, deionised	3.38E+08	Kg	Market for water, deionised water, deionised Cutoff, U - Europe without Switzerland
Electricity, medium voltage	1463851.872	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Electricity, medium voltage	1829814.84	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Electricity, medium voltage	426956.796	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Injection moulding	6.29E+07	Kg	Injection moulding injection moulding Cutoff, U - RER
Polyethylene terephthalate, granulate, bottle grade, recycled	5.71E+07	Kg	Market for polyethylene terephthalate, granulate, bottle grade, recycled polyethylene terephthalate, granulate, bottle grade, recycled Cutoff, U - row
Polyethylene, high density, granulate	5855407.488	Kg	Polyethylene, high density, granulate, recycled to generic market for high density PE granulate polyethylene, high density, granulate Cutoff, U - Europe without Switzerland
Electricity, medium voltage	406625.52	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Printed paper, offset	182981.484	Kg	Market for printed paper, offset printed paper, offset Cutoff, U - GLO
Transport, freight, lorry 3.5-7.5 metric ton, EURO3	3.24E+08	Kg*km	Market for transport, freight, lorry 3.5-7.5 metric ton, EURO3 transport, freight, lorry 3.5-7.5 metric ton, EURO3 Cutoff, U - RER
Transport, freight, lorry >32 metric ton, EURO4	7.78E+11	Kg*km	Market for transport, freight, lorry >32 metric ton, EURO4 transport, freight, lorry >32 metric ton, EURO4 Cutoff, U - RER
Transport, passenger car	2.81E+07	Km	Market for transport, passenger car transport, passenger car Cutoff, U - RER
Hand gel 2 input			

2-Propanol (Elementary flows/Emission to air/high population density)	8.47E+08	Kg	N/A: elementary flow
2-Propanol (Elementary flows/Emission to water/unspecified)	1.73E+07	Kg	N/A: elementary flow
Hydrogen peroxide (Elementary flows/Emission to air/unspecified)	3580000	Kg	N/A: elementary flow
Hydrogen peroxide (Elementary flows/Emission to water/unspecified)	73000	Kg	N/A: elementary flow
Waste paperboard	182981.484	Kg	Market for waste paperboard waste paperboard Cutoff, U - GB
Waste polyethylene	5855407.488	Kg	Market for waste polyethylene waste polyethylene Cutoff, U - GB
Waste polyethylene terephthalate	5.71E+07	Kg	Market for waste polyethylene terephthalate waste polyethylene terephthalate Cutoff, U - GB
Wastewater, from residence	3.65E+08	L	Market for wastewater, from residence wastewater, from residence Cutoff, U - row
Liquid soap inputs			
Soap	4.94E+08	Kg	Market for soap soap Cutoff, U - GLO
Electricity, medium voltage	686180.565	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Electricity, medium voltage	160108.7985	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Injection moulding	2.36E+07	Kg	Injection moulding injection moulding Cutoff, U - RER
Polyethylene terephthalate, granulate, bottle grade, recycled	2.14E+07	Kg	Market for polyethylene terephthalate, granulate, bottle grade, recycled polyethylene terephthalate, granulate, bottle grade, recycled Cutoff, U - row
Polyethylene, high density, granulate	2195777.808	Kg	Polyethylene, high density, granulate, recycled to generic market for high density PE granulate polyethylene, high density, granulate Cutoff, U - Europe without Switzerland
Electricity, medium voltage	152484.57	Kwh	Market for electricity, medium voltage electricity, medium voltage Cutoff, U - GB
Printed paper, offset	68618.0565	Kg	Market for printed paper, offset/printed paper, offset/Cutoff, U-GLO

Tap water	1.22E+12	Kg	Market for tap water tap water Cutoff, U - Europe without Switzerland
Washing, drying and finishing laundry	1.86E+09	Kg	Washing, drying and finishing laundry washing, drying and finishing laundry Cutoff, U - GLO
Transport, freight, lorry 3.5-7.5 metric ton, EURO3	1.29E+08	Kg*km	Market for transport, freight, lorry 3.5-7.5 metric ton, EURO3 transport, freight, lorry 3.5-7.5 metric ton, EURO3 Cutoff, U - RER
Transport, freight, lorry >32 metric ton, EURO4	3.11E+11	Kg*km	Market for transport, freight, lorry >32 metric ton, EURO4 transport, freight, lorry >32 metric ton, EURO4 Cutoff, U - RER
Transport, passenger car	1.05E+07	Km	Market for transport, passenger car transport, passenger car Cutoff, U - RER
Liquid soap outputs			
Wastewater, unpolluted, from residence	1.22E+12	L	Market for wastewater, unpolluted, from residence wastewater, unpolluted, from residence Cutoff, U - row
Waste paperboard	68618.0565	Kg	Market for waste paperboard waste paperboard Cutoff, U - GB
Waste polyethylene	2195777.808	Kg	Market for waste polyethylene waste polyethylene Cutoff, U - GB
Waste polyethylene terephthalate	2.14E+07	Kg	Market for waste polyethylene terephthalate waste polyethylene terephthalate Cutoff, U - GB